SCIENTIFIC BOOKS

Biochemie der Pflanzen. Von Dr. Friedrich Czapek, Professor der Anatomie und Physiologie der Pflanzen an der K. K. Deutschen Universitaet in Prag. Zweite, umgearbeitete Auflage. Erster Band, pp. xix., 828, mit 8 Abbildungen im Text. Verlag von Gustav Fischer, Jena, 1913. M. 24.00, geb. M. 25.20.

In reviewing a recent foreign treatise on organic chemistry, one of our best chemists, who is also very favorably known as an investigator, made the remark that it was so much more difficult to teach organic chemistry to-day than it was a generation ago, apparently for the reason that the field to be covered is so much greater now than it was then. Recently a graduate student, who was attending a course of lectures on organic chemistry by way of review, made the statement that in the course of his college career he had heard a number of organic chemists lecture and that while their method of presenting the subject differed in each case, the lecturer had invariably introduced his topic by stating that he did not expect his students to learn something about each of the hundred thousand and some odd tens of thousands of organic compounds catalogued in Beilstein and its supplements. It would seem that some of the horror which so many students experience, or at least feign to experience, at the number of organic compounds when they first approach the subject, is due in part at least to their teachers. While we profess that we are not frightened by the numbers of carbon compounds and inform our students at the outset that they need not be horror-stricken by any such mass action, yet we seem to feel, and even proclaim that, because of the enormous strides made by organic chemistry, we need more time than formerly to cover the ground though but in an elementary fashion. If, *e. g.*, we measure the growth of organic chemistry by the ten thousand or more carbon compounds that have been added to our catalogue in a given period, then indeed our point of view must make us pessimistic as to the ultimate outcome of our success as teachers of the elementary part of our subject in any rational allotment of time at our disposal during the college quadrennium.

Any organic chemist who has reached middle age may well appreciate the mental state of chemists of the old school who found themselves confronted by Kekulé's structural theory. But, if they were confounded it was due, not so much to the rapid growth in the number of compounds that resulted from the application of Kekulé's views, as from the different mental attitude that the structural theory demanded. The Grignard reaction, though in short space it has produced thousands of new compounds at a time when the progress in organic chemistry was referred to as having become sluggish, wrought no visible disturbance whatever for the simple reason that it brought no new fundamental theories into play, hence made no demands on our mental attitude toward the subject. Any one who has studied the life of Liebig carefully must have noticed that underneath the surface there was something more than dissatisfaction toward the university administration that caused him to leave Giessen. The theory of substitution was revolutionizing organic chemistry in spite of Liebig's attitude and in spite of the "S. C. H. Windler" which Woehler hurled at the French chemists. But whereas Woehler adapted himself as well as he could and stuck to his post and his "Fach," Liebig found it more convenient not only to migrate, geographically speaking, but to "umsteigen"—if this apt expression by Mark Twain may be permitted in so serious a topic as this—or to "umsatteln" if a German phrase when applied to the change of a German chemist from the pure to the applied seem preferable.

The structural development of organic chemistry has made it possible to treat the subject-matter deductively rather than inductively. The claim of inductive treatment in science has become a sort of fetish. We have preached this doctrine to such an extent to our students that we dare not admit that

our method of procedure after the first or second lecture is largely deductive. If in organic chemistry we have the courage to be outspokenly deductive from the start and insist on its logical consequences, half of the battle is won. To be sure there are still a sufficient number of difficulties to be overcome, but they do not consist in numbers, but rather in the possibility of acquiring the right mental attitude.

To a large extent plant chemistry is organic chemistry. However, whereas most of the new organic compounds that are produced synthetically find a convenient place in the well-regulated drawing room of organic chemistry, most of the new substances isolated from the vegetable kingdom—and many of the old timers from the same source—still belong to the lumber chamber of organic chemistry.

It is true that organic chemistry consists of something more than the study of the physical and chemical properties of chemical individuals containing all the way from one to a host of carbon atoms. Modern organic chemists with adequate physico-chemical training appear but too anxious to rub this fact into their older colleagues. This is equally true of the organic chemistry of the vegetable kingdom, but to a much greater degree. The "Grundlagen und Ergebnisse der Pflanzenchemie" by Euler, one part of which consists of a briefly descriptive catalogue of the *materia phytochemica* and two parts of which are a text on physical chemistry with occasional phytochemical application, are but a partial expression of the truth of the above assertion. Great as has been the development of physical chemistry, more particularly since Ostwald "made school" at Leipzig, it has scarcely begun to explain the problems of the "Biochemistry of the Plants," though it has touched upon this subject at innumerable points. Whereas the application of structural chemistry to the *materia phytochemica* has made possible a large amount of systematization and has thus simplified the situation, physical chemistry has thrown but dim light on innumerable spots. The status of the application of physical chemistry to biochemical problems is approximately that of the status reached in organic chemistry when Berzelius characterized the discovery of the benzoyl radicle by Liebig and Woehler as the dawn of organic chemistry. Daylight is beginning to dawn in the study of biochemical problems, but before daylight appears much more generalization will have to be made possible, not only by the extension of present physico-chemical methods over a large field, but by a much better understanding in each and every department of biochemical research. The single chapter of catalysis, always a convenient word to cover our ignorance, and its application to enzyme action is sufficient illustration.

To attempt to write a comprehensive biochemistry of plants under present conditions is a stupendous undertaking. The mere cataloguing of the constituents of plants as attempted by Wehmer in his "Pflanzenstoffe" for the Phanerogams has proved sufficiently burdensome to discourage even the most ardent compiler. Hence one is not surprised to learn that Czapek has gladly availed himself of the opportunity to unload a part of this work, as undertaken in the first edition, by referring his readers to Wehmer for more complete data so far as the constituents of phanerogams are concerned. Yet in spite of this limitation, the first volume has grown enormously. If it is more of a true biochemistry than was the corresponding volume of the first edition, this is due not so much to this sort of unburdening as it is due to the greater attention and more space given to general considerations. Readers of this review who have been accustomed to resort freely to the first edition for information may be interested to compare the figures given in the following outline of the contents of the second edition with the corresponding figures of the first. At the same time the following data will give a better idea of the contents to those not already acquainted with Czapek.

Preceded by a short historical introduction of nineteen pages, the contents of the volume are classified under two general heads, viz.,

General Biochemistry (pp. 20 to 240) and Special Biochemistry (pp. 240 to 820). The first part is subdivided into four chapters:

1. The substratum of the chemical changes in the living organism, the protoplasm (pp. 20 to 65).

2. The chemical reaction in the living plant organism (pp. 66 to 146) including such topics as the conditions of the reactions, the time element, catalysis, enzymes, immunity.

3. Chemical stimulation (pp. 147 to 233) including growth in all of its aspects.

4. Phenomena of chemical adaptation and inheritance (pp. 234 to 239).

The subject-matter under special biochemistry is arranged into parts, divisions and chapters. Part I. deals with Saccharides and the rôle which they play in plant metabolism (pp. 240 to 708). The "general division" discusses the vegetable sugars. The "special division" takes up the following subjects in as many chapters:

5. The sugars and carbohydrates in fungi and bacteria.

6. The resorption of sugars and carbohydrates by fungi and bacteria.

7. The carbon assimilation and sugar formation by fungi and bacteria.

8. The carbohydrate metabolism in the Algæ.

9. The reserve carbohydrates of the seeds.

10. The resorption of sugar and carbohydrates in the germinating seeds.

11. The formation of reserve carbohydrates in the seed.

12. The carbohydrate metabolism in underground reserve organs.

13. The carbohydrate metabolism in shoots and leaf buds.

14. The carbohydrate metabolism in foliage leaves.

15. The carbohydrate metabolism in the reproductive system.

16. The carbohydrate metabolism in phanerogamic parasites and saprophytes.

17. Resorption of carbon compounds by means of the roots and leaves of phanerogams.

18. Secretion of sugar and carbohydrates.

The phytochemical synthesis of sugar in the chlorophyll receives an exhaustive treatment (pp. 506 to 628). The subject of saccharides as skeleton substances of the plant body is similarly treated.

Part II., the last part of the first volume, is devoted to the lipoids in plant metabolism, which subject is treated under two principal heads: the nutritive lipoids and the cytolipoids. Under the former head we find,

22. The reserve fats of the seeds.

23. The resorption of fats during the germination of the seed.

24. The formation of fats in ripening seeds and fruits.

25. Reserve fats in stems, etc., and foliage leaves.

26. Fat as reserve material in thallophytes, mosses, ferns and pollen grains.

Under the head of cytolipoids the following subjects are discussed:

27. Vegetable lecithines (phospholipoids).

28. Vegetable cerebrosides.

29. Sterinolipoids of plants.

30. Vegetable chromolipoids.

31. The production of wax (cerolipoids) in plants.

Thus it becomes apparent that volume one, although it has greatly increased in size, considers but two groups of phytochemical substances and the biological problems which they suggest. If the chemistry of the simple saccharides has been in a fairly satisfactory condition since Fischer paved the way to a better understanding, we must not forget that we have but entered the vestibule of a carbohydrate chemistry and that the problem of the photosynthesis of the simplest sugar has not yet been solved to the complete satisfaction of the physiologist.

It has evidently been the endeavor of Czapek to bring together the available information on a given subject and to classify the information as indicated by the chapter headings quoted above. This manner of treatment does not make a good text-book, but with the extensive references to original literature

it makes an admirable reference book. Czapek has also refused to assume the rôle of arbiter, but quotes, with as little prejudice as can be expected, the opinions of each individual, leaving it to the reader to arrive at his own conclusion.

In closing, a single allusion to the greater importance that is being accorded to phytochemistry in recent years may not be out of place. For more than a generation after the announcement of the benzene theory by Kekulé, organic chemists could think of little else than synthesized substances and of coal tar as their gold mine. So one-sided were they at times that they did not even see the element of the ridiculous in the suggestion to make foodstuffs artificially from this source. The other extreme has now been reached by the pure-food chemist who by big head lines in the newspapers and the waving of red rags before large audiences denounces this same coal tar as the source of everything that is bad. A much more common sense reaction has been started by those chemists who have been pointing out how the intricate process of the plant laboratory may be husbanded for the benefit of mankind by farmers who need not be Ph.D.'s but who have been taught by the biochemist to make the most of their opportunities.

Again, while we should welcome the new synthetic remedies that have been turned out by the "Farbenfabriken" of the fatherland, we should not forget that in this field also the plant still produces valuable remedies which we can obtain as well or better from living or recently dead plants than as a by-product from fossilized plants of former geological ages.

But aside from the agricultural and pharmaceutical or medical aspects which the chemical study of plants and plant life may afford, the study of these subjects for its own sake has a charm all its own. Who can view the beautiful color of the flowers or inhale their perfume without feeling that a knowledge of the processes by which the plant produces these physiological effects on the intelligent animal is in itself worth knowing though the pigment never be used to dye a fiber, nor the perfume be extracted in order to find a place on my lady's toilet table EDWARD KREMERS

A History of Land Mammals in the Western Hemisphere. By WILLIAM BERRYMAN SCOTT, Blair Professor of Geology and Paleontology in Princeton University. New York, The Macmillan Company, 1913. Pp. i–xiv + 1–693, with frontispiece and 304 text-figures.

In this striking volume Professor Scott has striven to assemble and set before the lay reader a judicious selection from the great accumulation of facts which the many students of mammalian paleontology have discovered. The presentation of the subject is essentially different from that of Professor Osborn's "Age of Mammals" wherein the rise and spread of faunas are treated as a succession of historical events. In the present work, after certain introductory chapters, the treatment is zoological, the life history of each of a number of important orders being discussed from beginning to end. Thus the two works by two of the foremost American paleontologists are supplemental; collectively they give a complete picture of Tertiary time.

The first two chapters of Professor Scott's book acquaint one with the methods pursued by the student of past life, the one showing the way whereby the geological data are interpreted, and the other the methods of paleontological research—how animals are preserved from the remote past, the nature of the remains, the way in which the characters they show are explained, and the method whereby the animal is reconstructed as a living being. A chapter on the principles of taxonomy is concluded by a full mammalian classification which is almost identical with that given by Professor Osborn in the "Age of Mammals," the only differences being relatively unimportant. The discussion of the skeleton and teeth of mammals, so essential to an understanding of fossil evidence, is followed by a chapter on the principles of geographical distribution of mammals and a summary of the successive mammalian faunas.

The succeeding chapters elucidate the histories of the principal orders: the Perissodac-